DOCUMENT RESUME

ED 269 458 TM 860 312

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TITLE Correlates of Cognitive Student Outcomes.
PUB DATE Apr 86
NOTE 43p.; Paper presented at the Annual Meeting of the American Educational Research Association (70th, San Francisco, CA, April 16-20, 1986). Appendices contain small print.
PUB TYPE Speeches/Conference Papers (150) -- Reports - Research/Technical (143)

EDRS PRICE MF01/PC02 Plus Postage.
DESCRIPTORS *Academic Achievement; *Cognitive Tests; Conventional Instruction; *Correlation; Educational Assessment; Educational Environment; Elementary Secondary Education; *Family Environment; Grade 5; Grade 8; Grade 11; Perception; *Scores; Sex Differences; Socioeconomic Status; Statewide Planning; Test Results
IDENTIFIERS *Ecological Paradigm; *Pennsylvania Educational Quality Assessment

ABSTRACT

A study of the correlates of cognitive achievement in Pennsylvania's Educational Quality Assessment Program was conducted by examining both individual (student level) and ecological (building level) correlations. Analyses were completed for grade levels 5, 8 and 11 for the 1985 state assessment. Twenty-four student derived condition variables or education indicators, classified as home environment, school environment and perception of instructional processes served as correlates. The education indicators classified as school environment were significantly associated with building achievement at nearly each grade level. Partialling out the effect of socioeconomic status (SES0 reduced the relationship between achievement and student perception of study habits to non-significance; however, perception of classroom discipline, interest in school and self-concept exhibited reductions of just 1 to 7 percent of the variance, thereby retaining modest relationships with building achievement. Generally weak relationships were observed between building achievement and perceptions of instructional process. A major exception occurred for timely return of teacher tests at grade 8, which exhibited a strong relationship with building achievement essentially unaffected by partialling on SES. A summary of instruments for measuring student achievement outcomes and a chart describing condition variables or education indicators are appended. (Author/PN)

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ED269458

# CORRELATES OF COGNITIVE STUDENT OUTCOMES

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Presented at the annual meeting of the
American Educational Research Association

San Francisco, California
April, 1986

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## ABSTRACT

A study of the correlates of cognitive achievement in Pennsylvania's Educational Quality Assessment program was conducted by examining both individual (student level) and ecological (building level) correlations. Analyses were completed for grade levels 5, 8 and 11 for the state assessment of 1985. Twenty four student derived condition variables or education indicators, classified as home environment, school environment and perception of instructional processes served as correlates. Results at both the student level and the school level were highly consistent from one cognitive outcome to another. Although socio-economic level was a prominent effect in building level analyses, significant relationships remained after partialling for certain education indicators.

Correlates of Cognitive Student Outcomes

Richard L. Kohr

Pennsylvania Department of Education

## INTRODUCTION

The variety of school and community variables collected by Pennsylvania's Educational Quality Assessment (EQA) program annually prompts many to raise the question of what types of variables relate to school achievement. The EQA program develops statistical relationships in two major ways. First, when data in the form of school mean scores are used as the unit of analysis, inferences may be drawn regarding building level achievement but not individual student performance. A second level of analysis, incorporating individual student scores, permits an examination of the relationships between student achievement and other student level variables such as time spent reading at home, amount of television viewing or educational level of parents. Thus, the primary intent of this investigation was to examine the correlates of cognitive performance in terms of both ecological (building level) and individual (student level) relationships.

### Background of the Assessment Program

Pennsylvania's EQA program has provided a school building assessment on each of the state adopted goals of quality education for the past 16 years. Students at 5th, 8th and 11th grades were tested in 10 areas, eight of which

were cognitive (reading, writing, mathematics, arts and humanities, analytical thinking, social studies, science, environment) and two noncognitive (self-concept in school and health practices). Data were also collected on a series of student background variables such as student perception of parental interest in school, frequency of residential change, television viewing, perceived expectations of parents and teachers, time spent reading at home, frequency of writing assignments, timely return of teacher tests, hours of student employment per week, etc. This information together with data obtained from a teacher questionnaire is summarized in an extensive 40 page report returned to the school during a 2 to 3 hour interpretation session conducted by an EQA staff member.

Data Source

Assessment in participating school districts was conducted during the first two weeks of March. Every building in the district housing a 5th, 8th or 11th grade underwent assessment and all students within those grade levels were involved. The testing procedure involved multiple matrix sampling to reduce testing time for individual students. Answer sheets were scanned and scored electronically.

All analyses were conducted on the 1985 assessment data. The state normative sample consisted of 99 districts involving 361 elementary schools, 138 junior high or middle schools and 111 high schools. This represented approximately 20% of the districts in Pennsylvania. Although involvement in assessment was voluntary, strong efforts were made to ensure geographic balance and representativeness in terms of district size and wealth. Approximately 26,000 students were tested in each grade level.

Student Outcome Measures

The EQA instrument package contained eight or nine cognitive measures consisting of multiple choice items. The number of items per instrument often varied according to grade level as noted by the range given in parentheses: reading comprehension (48 items), writing skills (60-64 items), mathematics (60 items), analytical thinking (32-33 items), citizenship/social studies (48-60 items), arts and humanities (36-48 items), science and technology (36-44 items), environment (27-40 items) and health knowledge (grade 5 only -- 51 items). Brief descriptions of these instruments may be found in Appendix A. A more extensive description of the test package along with technical properties is given in the Educational Quality Assessment Commentary and the Educational Quality Assessment Data manuals (Pennsylvania Department of Education, 1985a, 1985b). Previous research found that the EQA basic skills tests correlated between .70 and .85 with similar measures in six major commercial standardized test packages (Blust & Kohr, 1981).

Student outcome scores were converted into standard scores (with mean of 50 and standard deviation of 10) in order to control for slight differences that occur depending on which test form a student received. The matrix sampling technique used by EQA involved 4 forms at grades 8 and 11 and 3 forms at grade 5. During test administration, booklets were distributed in such a way that an essentially random 4th (or 3rd) of the students received a given form. All students responded to an equal number of items on each of the areas assessed. For instance, there were 60 items in mathematics in the overall assessment, with each form consisting of a different set of 15 (or 20) items. The original

assignment of items to forms was done in such a way as to minimize form to form differences in difficulty.

Condition Variables or Education Indicators

Students also responded to a series of items comprising 14 to 24 characteristics known as "condition variables," in the EQA program since they reflect home and school conditions believed to affect achievement. These variables depict characteristics of home environment, school environment and student perception of processes related to instruction. Recently, variables like these have been termed "education indicators" or simply "indicators" by federal efforts to identify appropriate measures of social conditions affecting educational progress (Department of Education, 1985). Most of the variables collected by EQA would fall in the category referred to as "context of education," and most particularly within the subcategories of student characteristics and school environment.

Listed below are the EQA condition variables or education indicators organized according to a structure that seemed logical for ease of discussion.

Home Environment

- Parental education
- Amount reading material in the home
- Mobility of residence
- Television viewing at home
- Time spent reading at home

Perception of parental interest in school

Perception of parental encouragement

Perception of parental expectations (Gr. 8 & 11 only)

Student educational expectations (Gr. 8 & 11 only)

Hours work outside home per week (Gr. 11 only)

School Environment

Perception of teacher expectations

Perception of classroom discipline (Gr. 8 & 11 only)

Interest in school

Self concept in school

Perception of testing situation

Perception of own study habits/plan schoolwork

Perception of Instructional Processes

Perceived frequency of writing assignments

Time spent on math homework assignments

Perceived frequency of teacher tests

Perceived timely return of teacher tests (Gr. 8 & 11 only)

Estd time spent in classroom lecture (Gr. 8 & 11 only)

Estd time spent in classroom discussion (Gr. 8 & 11 only)

Estd time spent on homework during class (Gr. 8 & 11 only)

Estd time spent silent reading during class (Gr. 8 & 11 only)

## RESULTS

### Correlations Among Cognitive Outcome Measures

The picture emerging from correlational analysis of cognitive outcomes was hardly surprising in revealing relationships consistently in the .40 to .60 range. Thirty six correlation coefficients at grade five ranged from .43 to .62 with a median of .51. At grade eight, twenty eight correlations went from .45 to .59 with a median of .52. Likewise, twenty eight correlations at grade eleven ranged from .41 to .59 with a median of .53.

### Gender Differences

Although most correlations between gender and cognitive outcomes were low there were some interesting systematic differences in the nature of the relationships. Since gender was coded 0 for male and 1 for females, a positive correlation signifies higher performance for females while a negative correlation reflects higher attainment for males. As may be observed in Table 1 females demonstrated higher performance across grade levels in the areas of writing skills, arts and humanities and analytical thinking. Males performed consistently higher in the knowledge areas of environment and science. Of the 21 statistically significant correlations eight favored males and thirteen favored females.

Table 1

Correlations Between Gender and Cognitive Outcome

| Cognitive Outcome | Grade 5 | Grade 8 | Grade 11 |
|---|---|---|---|
| Writing Skills | .14 | .19 | .20 |
| Mathematics | .01 | -.01 | -.06 |
| Reading Comprehension | .04 | .08 | .11 |
| Arts and Humanities | .09 | .13 | .12 |
| Environment Knowledge | -.05 | -.06 | -.16 |
| Analytical Thinking | .10 | .10 | .13 |
| Citizenship Knowledge | -.12 | .03 | .00 |
| Science Knowledge | -.07 | -.10 | -.13 |
| Health Knowledge | .06 | N/A | N/A |

N/A - indicates Health Knowledge was not measured at grades 8 and 11

Sample sizes: Gr. 5 (n = 24,000), Gr. 8 (n = 29,700), Gr. 11 (n = 27,000)

Correlations of .03 are significant at the .001 level.

## Consistency of Correlations Between Education Indicators and Cognitive Outcomes

The pattern of correlations between education indicators and cognitive outcomes was characterized by a marked consistency. Without exception the magnitude of the correlations for a particular achievement indicator showed little variation from one cognitive outcome to another. To illustrate, parental education consistently correlated most highly with arts and humanities and least with analytical thinking at each grade level. These correlations were .17 and .24 (grade five), .19 and .27 (grade eight) and .19 and .29 (grade eleven). The median correlation between parental education and the cognitive outcome measures was .18 at grade five and .22 at grades eight and eleven. In terms of percentage of variance accounted for the difference between the smallest and largest correlations listed above was only three percent at grades five and eight and four percent at grade eleven. Since the pattern was so consistent there was little to be gained by presenting tables displaying individual correlations between each education indicator and each cognitive outcome. Given the reasonably high correlations observed among cognitive outcomes, such a pattern is hardly surprising. To simplify the presentation of data and to gain greater stability of results a total achievement score, obtained for each student by summing the standardized scores across cognitive outcomes, was correlated with the education indicators.

Summarized in Table 2 are the correlations between total achievement and the education indicators or condition variables. By virtue of the large sample size nearly all correlations were statistically significant. As a group the correlations classified as reflecting home environment are the largest in

Table 2

Summary of Student Level Correlations Between Total Achievement and Education Indicators

| Education Indicators or Condition Variables | Grade Level 5 | 8 | 11 |
|---|---|---|---|
| **Home Environment** | | | |
| Parental education | .25 | .29 | .30 |
| Amount of reading material in the home | .25 | .29 | .28 |
| Mobility of residence | -.13 | -.16 | -.14 |
| Television viewing at home | -.12 | -.12 | -.14 |
| Time spent reading at home | .18 | .21 | .23 |
| Perception of parental interest in school | .17 | .25 | .26 |
| Perception of parental encouragement | .26 | .40 | .41 |
| Perception of parental expectations | N/A | .42 | .49 |
| Student educational expectations | N/A | .48 | .54 |
| Hours of work outside home per week | N/A | N/A | -.10 |
| **School Environment** | | | |
| Perception of teacher expectations | .11 | .23 | .29 |
| Perception of classroom discipline | N/A | .17 | .22 |
| Interest in school | .16 | .23 | .25 |
| Self concept in school | .34 | .34 | .35 |
| Perception of testing situation | .32 | .30 | .29 |
| Perception of own study habits/plan schoolwork | .31 | .32 | .22 |
| **Perception of Instructional Processes** | | | |
| Perceived frequency of writing assignments | .03 | .09 | .14 |
| Time spent on math homework assignments | -.12 | .11 | .18 |
| Perceived frequency of teacher tests | .01 | -.02 | -.02 |
| Perceived timely return of teacher tests | N/A | .25 | .19 |
| Estd time spent in classroom lecture | N/A | .07 | .17 |
| Estd time spent in classroom discussion | N/A | -.09 | -.15 |
| Estd time spent on homework during class | N/A | -.24 | -.31 |
| Estd time spent silent reading during class | N/A | -.30 | -.38 |

N/A = indicates variable was not measured at a particular grade level

Sample sizes: Gr. 5 (n = 24,000), Gr. 8 (n = 29,700, Gr. 11 (n = 27,000)

Correlations of .03 are significant at the .001 level

magnitude. Particularly noteworthy are the correlations which range from .40 to .49 for parental encouragement and expectations at grades 8 and 11. It is interesting that parental support outdistanced the correlations obtained by conventional measures of SES, parental education and amount of reading material in the home. Within each grade level the students own educational expectations, which, not surprisingly, correlates with parental expectations, correlated most highly with total achievement. Low positive correlations were found between achievement and time spent reading at home and perception of parental interest in school. Low negative correlations were found between achievement and mobility of residence, indicating that more frequent changes of school due to moving residence was associated with somewhat lower performance. A slight negative relationship with achievement was found for the number of hours students work outside the home for 11th graders. Consistent with much past research a low negative relationship was found between leisure television viewing and achievement at each grade level (Williams, Haertel, Haertel & Walberg, 1982 and Neuman, 1986).

The student perceptions subsumed under "school environment" predominantly deal with classroom climate characteristics identified by the research on effective schools and similar to certain "high inference" scales (Chavez, 1984) and to measures of student morale (Anderson, 1982). Student perceptions of study habits/planning of school work doesn't fit into this category cleanly, nor does it fit any better elsewhere. Since study habits/planning may result from school initiated efforts and be part of the expectations of teachers (and hopefully reinforced at home) it is included here with modest correlations with total achievement. Particularly consistent across grade levels were the correlations for self concept in school and for student perception of the

testing situation which accounted for approximately nine to twelve percent of the test score variance. Although student perceptions of teacher expectations were positively related to total achievement the correlations were not as large as observed for parental expectations. For instance, at grade 11 the difference between .29 and .49 is statistically significant and accounts for 15 percent more variance. Perception of classroom discipline, which derives from the research on effective schools concern with safe and orderly school environments, also had low positive correlations with total achievement.

The group of indicators labeled "perception of instructional process" represents an effort to measure, through student perceptions, some of the factors influencing achievement identified by research on effective schools and by studies dealing with engaged instructional time. The most consistent set of findings in the present data occurred in the grade 8 and 11 correlations between total achievement and estimated time devoted to specific classroom activities. For both grade levels time spent in classroom lecture activity had a low positive correlation with achievement but the relationship became progressively negative for class time spent in discussion, doing homework and reading silently.

Curvilinear Relationships

Analyses were conducted for potential curvilinear relationships in the data. In most instances a quadratic or cubic model failed to improve upon the linear model by more than one or two percent of the test score variance. Only student perception of teacher expectations at both grades eight and eleven displayed an improvement of as much as four percent of the variance through a

quadratic model. In essence, the linear model was sufficient in describing the data in a meaningful way.

Subgroup Analyses Based on Community Type

Correlations were computed separately for students from rural, suburban and urban communities. A comparison of the correlations revealed highly similar patterns across community type with very few differing in a statistically significant way. In most instances the correlations differed in terms of percentage of variance accounted for by only one to three percent. As a result the conclusions drawn from the analyses would be identical and a presentation of tabled results would serve little purpose other than demonstrate consistency in the observed relationships.

Subgroup Analyses Based on Gender

Correlations between education indicators and total achievement were computed separately for males and females. Considering the three grade levels there were 62 comparisons of which 17 were found to differ significantly at the .001 level. These correlations, summarized in Table 3, revealed differences in percentage of variance accounted for ranging from one to eight percent. Most noteworthy were the correlations for student perception of the testing situation which consistently showed a higher relationship with achievement for males than for females, accounting for five to eight percent more variance. The negative correlation for estimated time spent on homework or silent reading during class time was consistently larger for males than for females suggesting that males

Table 3

Statistically Significant Correlations Between Total Achievement and Education Indicators for Male and Female Subgroups

| Education Indicators or Condition Variables | Grade Level | Male | Female | $r^2$ Diff |
|---|---|---|---|---|
| **Home Environment** | | | | |
| Television | 11 | -.09 | -.09 | .03 |
| Time spent reading at home | 11 | .25 | .19 | .03 |
| **School Environment** | | | | |
| Perception of teacher expectations | 8 | .20 | .27 | .03 |
| Perception of classroom discipline | 11 | .23 | .19 | .02 |
| Interest in school | 11 | .28 | .22 | .03 |
| Self concept in school | 11 | .37 | .32 | .04 |
| Perception of testing situation | 5 | .36 | .25 | .07 |
| | 8 | .33 | .24 | .05 |
| | 11 | .34 | .20 | .08 |
| Perception of study habits/plan schoolwork | 11 | .18 | .28 | .04 |
| **Perception of Instructional Processes** | | | | |
| Estd time spent in classroom lecture | 8 | .04 | .12 | .01 |
| | 11 | .15 | .20 | .02 |
| Estd time spent in classroom discussion | 11 | -.13 | -.18 | .02 |
| Estd time spent on homework during class | 8 | -.25 | -.21 | .02 |
| | 11 | -.33 | -.28 | .03 |
| Estd time spent silent reading during class | 8 | -.32 | -.28 | .02 |
| | 11 | -.41 | -.34 | .05 |

Sample sizes:
Male: Gr. 5 (n = 12,200), Gr. 8 ( n= 15,200), Gr. 11 (n = 13,500)
Female: Gr. 5 (n = 11,800). Gr. 8 (n = 14,500), Gr. 11 (n = 13,500)

Correlations of .04 are significant at the .001 level.

may be somewhat more vulnerable to achievement deficits when direct instructional procedures are absent.

Subgroup Analyses Based on Parental Education

Parental education was used to define two SES groups. Low SES was defined as a case in which the parent with the highest educational level was a high school graduate or less. High SES referred to a parent having post high school education which included two years of special vocational training or two years of college, a college degree or an advanced degree. Correlations between education indicators and total achievement were computed for each SES group. The pattern of correlations were highly similar from group to group with very few differing significantly. The only consistent significant differences across grade levels were observed for television viewing where the correlations for the low SES group were -.07, -.04 and -.01 for grades 5, 8 and 11. Correlations for the high SES group were -.13, -.14 and -.15 respectively. These differences only represent from one to two percent of test score variance. Slightly larger were differences between correlations observed for achievement and perception of teacher expectations at two grade levels. At grade 8 the correlations were .15 and .25 for low and high SES groups and at grade 11 they were .22 and .31, respectively. These results favored the high SES group by about four or five percent more variance.

## Relationship of School Cognitive Performance and Education Indicators

In the Pennsylvania EQA program, as with most statewide assessment programs, the primary reporting unit is the school building. Data derived from students, teachers or department records are summarized in the form of school building mean scores. As such, correlations are reported in which the building serves as the unit of analysis. Correlations based on aggregated school data are generally larger than correlations based on individual student data. Robinson (1950) pointed out that correlations based on aggregated data, termed ecological correlation, should not be confused with or used as a substitute or individual correlation. Ecological correlations reflect the statistical relationship based on groups. Thus, in the results which follow, it should be kept in mind that the relationships refer to school building data, not individual student data.

The correlations between each education indicator or condition variable were initially examined with respect to their relationship to each of the cognitive outcomes. Although there was somewhat more range in the correlation coefficients across cognitive outcomes than was observed in the student level analyses, the patterns were still highly similar. Here again, it seemed redundant to present tabled results for each cognitive outcome. Instead correlations were computed between the education indicator and an index of total achievement obtained by summing building level standard scores. These correlations are presented in Table 4.

Table 4

Summary of School Level Correlations Between Total Achievement and Education Indicators

| Education Indicators or Condition Variables | Grade 5 | Grade 8 | Grade 11 |
|---|---|---|---|
| **Home Environment** | | | |
| Parental education | .52 | .48 | .51 |
| Amount reading material in the home | .56 | .52 | .51 |
| Mobility of residence | -.07 | -.17 | .13 |
| Television viewing at home | -.41 | -.48 | -.54 |
| Time spent reading at home | .26 | .07 | .12 |
| Perception of parental interest in school | .45 | .46 | .45 |
| Perception of parental expectations | N/A | .27 | .42 |
| Student educational expectations | N/A | .35 | .47 |
| Hours work outside home per week | N/A | N/A | .31 |
| **School Environment** | | | |
| Perception of classroom discipline | N/A | .32 | .50 |
| Interest in school | .19 | .31 | .51 |
| Self concept in school | .28 | .28 | .34 |
| Perception of study habits/plan schoolwork | .21 | .28 | .17 |
| **Perception of Instructional Processes** | | | |
| Perceived frequency of writing assignments | .14 | .07 | .16 |
| Time spent on math homework assignments | -.16 | .12 | .14 |
| Perceived frequency of teacher tests | -.08 | -.11 | -.07 |
| Perceived timely return of teacher tests | N/A | .50 | .24 |
| Estd time lecture/discussion in mathematics | N/A | -.02 | .27 |
| Estd time lecture/discussion in English | N/A | -.01 | .27 |
| Estd time lecture/discussion in science | N/A | .00 | .10 |
| Estd time lecture/discussion in social stud. | N/A | .09 | .34 |

N/A = indicates variable was not measured at a particular grade level

Sample sizes: Gr. 5 (n = 361), Gr. 8 (n = 138), Gr. 11 (n = 111)

Correlations significant at the .01 level are as follows:
Gr. 5 (r = .14), Gr. 8 (r = .23), Gr. 11 (r = .25)

The correlations between those education indicators which are reflective of socioeconomic status are considerably larger than those observed in Table 2 for student level data. Parental education and amount of reading material in the home are indicators of SES and consistently correlated about .50 with building level performance. Television viewing, traditionally a variable related to SES, demonstrated negative correlations with building achievement at much the same level as was reported for previous assessments (Kohr, 1979). Similarly, the correlations between school achievement and building level mean scores on student perception of parental interest, parental expectations and student expectations were predominantly in the 40's. Time spent reading at home was only significant at grade 5.

All but one of the school environment correlations was statistically significant. Particularly strong was student perception of classroom discipline and interest in school at grade 11. Self concept in school displayed very consistent correlations across grade levels.

As a group the perception of instructional process variables exhibited the weakest correlations with just six of 19 reaching significance. Most impressive was the .50 correlation between building achievement and perceived timely return of teacher tests at grade 8. In the EQA program building level mean scores in estimated classroom time spent in lecture and discussion were produced separately for mathematics, English, science and social studies. Although the correlations shown are with total achievement they were typical of what was observed for specific cognitive outcomes. The only significant correlations were found at grade 11.

Partial Correlations Between School Performance and Education Indicators

Partial correlation coeffients were computed between the education indicators and total achievement by removing or partialling out the effect of SES as measured by parental education. These correlations are presented in Table 5. As a result of partialling, the SES related variables would normally be expected to exhibit a reduction in their relationship to total achievement. This effect was observed for the following home environment variables: amount of reading material in the home, television viewing, parental interest in school and rather dramatically for parental expectations and student educational expectations.

For the school environment variables, partialling reduced perception of study habits to non-significance but perception of school discipline, interest in school and self concept in school displayed reductions of only one to seven percent of accounted for variance and remained statistically significant.

Among the perception of instructional process variables only three remained significant after partialling. The most potent variable was perceived timely return of teacher tests which remained at the same level of relationship at grade 8, but at grade 11 showed a rise in correlation from .24 to .38.

Table 5

Summary of School Level Partial Correlations Between Total Achievement and Education Indicators with the Effect of Parental Education Partialed Out

| Education Indicators or Condition Variables | Grade 5 | Grade 8 | Grade 11 |
|---|---|---|---|
| **Home Environment** | | | |
| Amount reading material in the home | .45 | .38 | .35 |
| Mobility of residence | -.19 | -.32 | -.21 |
| Television viewing at home | -.28 | -.47 | -.42 |
| Time spent reading at home | .13 | .01 | -.01 |
| Perception of parental interest in school | .29 | .32 | .33 |
| Perception of parental expectations | N/A | -.21 | .07 |
| Student educational expectations | N/A | -.06 | .15 |
| Hours work outside home per week | N/A | N/A | .20 |
| **School Environment** | | | |
| Perception of classroom discipline | N/A | .29 | .45 |
| Interest in school | .14 | .35 | .43 |
| Self concept in school | .20 | .23 | .31 |
| Perception of study habits/plan schoolwork | .04 | .13 | .07 |
| **Perception of Instructional Processes** | | | |
| Perceived frequenty of writing assignments | .10 | .10 | .18 |
| Time spent on math homework assignments | -.18 | .13 | .13 |
| Perceived frequency of teacher tests | -.03 | -.18 | .07 |
| Perceived timely return of teacher tests | N/A | .51 | .38 |
| Estd time lecture/discussion in mathematics | N/A | -.04 | .05 |
| Estd time lecture/discussion in English | N/A | -.04 | .12 |
| Estd time lecture/discussion in science | N/A | -.07 | .02 |
| Estd time lecture/discussion in social stud. | N/A | .03 | .23 |

N/A = indicates variable was not measured at a particular grade level

Sample sizes: Gr. 5 (n = 361), Gr. 8 (n = 138), Gr. 11 (n = 111)

Correlations significant at the .-01 level are as follows:
Gr. 5 (r = .14), Gr. 8 (r = .23), Gr. 11 (r = .25)

School Level Curvilinear Relationships

Analyses were conducted to determine whether a quadratic or a cubic model could improve upon the linear model in describing the relationship between education indicators and school level achievement. There was a general absence of the ability to establish a significant increase in correlation through the application of curvilinear models at grades 5 and 8. At grade 11, the only instances in which a curvilinear model accounted for significantly more variance than a linear model were for two outcome areas and not at all for total achievement.

## DISCUSSION

Analyses conducted in this study concentrated on individual student data but also included data aggregated at the school level. Correlations among student scores on the cognitive outcomes were substantial with the median coefficient approximately .52 at each grade level. This finding coupled with the fact that correlations between education indicators (or condition variables) and achievement were markedly similar from one cognitive outcome to another led to a decision to reduce redundancy by presenting results in terms of a total achievement score. Summing the standard scores across cognitive outcomes produced the total achievement score used in all subsequent student level analyses.

Efforts to identify interesting curvilinear relationships between student cognitive achievement and education indicators resulted in some statistically significant findings, however, since they generally accounted for only one to three percent more variance than the linear model, there were few substantive findings to report. For all practical purposes the linear model was sufficient to describe the data.

A variety of subgroup analyses were performed which explored the relationship between education indicators and student cognitive outcomes. Here again the pattern of correlations was similar across cognitive outcomes, providing further confirmation of the adequacy of the total achievement score in yielding representative results. An examination of the correlations from subgroup to subgroup revealed generally similar results regardless of whether the subgroups were based on community type (urban, suburban and rural) or on socioeconomic

status (parental education levels). Also, a consistently larger negative relationship between total achievement and estimated classroom time spent on homework or on silent reading was observed for males. The implication is that males may be more adversely affected when class time is spent on activities not directly related to instruction.

The analyses based on gender revealed some interesting differences in achievement. Females demonstrated higher performance in writing skills, arts and humanities knowledge and analytical thinking at each grade level. Males exhibited higher attainment in the related cognitive areas of science and environment knowledge at all three grade levels. This was consistent with the finding of a small but pervasive superiority on the part of males reported by Steinkamp and Maehr (1983) in their extensive review of science achievement. A comparison of correlations between education indicators and total achievement for male and female subgroups results in patterns that were quite similar but with some important exceptions. For instance, the association between a positive attitude toward the testing situation and total achievement was stronger for males than for females.

Education indicators or condition variables were classified according to whether they represented home environment, school environment or perceptions of instructional process. Individual student correlations between total achievement and education indicators revealed some interesting findings. For secondary students the association between total achievement and parental encouragement, parental expectation and student educational expectations was stronger than the relationship observed for parental education, amount of reading material in the

home and student perception of parental interest in school. Negatively related to total achievement were the amount of leisure television viewing, the number of different schools attended as a result of changing residence and, for 11th graders, the number of hours the student works per week.

Within the school environment area, and at all grade levels, total achievement was positively related to self concept, student perceptions of testing situation and to student self perceptions of study habits. Perception of classroom was mildly related to achievement and perception of teacher expectations demonstrated a progressively stronge relationship with achievement across grade levels.

Of particular interest in the area of student perception of instructional processes were the modest negative relationship found between student achievement and estimated classroom time spent doing homework or engaging in silent reading. This finding is consistent with the research on engaged instructional time in that neither activity qualifies as direct instruction.

Correlations conducted at the school building level, often referred to as ecological correlations, revealed the not surprising fact that a high degree of relationship existed between cognitive outcomes. Thus, schools scoring high in one cognitive area tend to score high on other cognitive areas. Statistically, the median correlation among cognitive outcomes was .67 at grade 5 and .76 at grades 8 and 11. As in the student level analyses, each education indicator or condition variable had similar correlations across cognitive outcomes, leading to the development of a total achievement score as a suitable index for subsequent school level analyses.

Within the home environment education indicators, building mean scores based on parental education and on amount of reading material in the home correlated with school level achievement in the .50s. Characteristically, television viewing had a substantial negative relationship with achievement. Other SES related variables such as parental interest in school, parental expectations and student educational expectations had a more modest relationship with achievement. When the effect of SES was statistically removed by partialling on parental education there was only a slight reduction in the relationship between achievement and television viewing and amount of reading material in the home, but quite a dramatic reduction occurred for parental interest in school, parental expectations and student expectations. In an ecological sense then, student educational expectations, parental interest and expectations are closely associated with the SES composition of the school and when the SES effect is removed, little association with school level achievement remains.

The education indicators classified as school environment were significantly associated with building achievement at nearly each grade level. Partialling out the effect of SES reduced the relationship between achievement and student perception of study habits to non-significance; however, perception of classroom discipline, interest in school and self concept exhibited reductions of just 1 to 7 percent of the variance, thereby retaining modest relationships with building achievement.

Generally weak relationships were observed between building achievement and perceptions of instructional process. A major exception occurred for timely return of teacher tests at grade 8 which exhibited a strong relationship with building achievement which was essentially unaffected by partialling on SES.

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# APPENDIX A

## Description of Instruments Measuring Student Achievement Outcomes

## SUMMARY OF INSTRUMENTS

| Rationale/Measurement | Subscales and/or Sample Items | Response Choices /Scoring |
|---|---|---|
| **FULL MEASURES** | | **MATRIX SAMPLED, ALL DATA** |
| **COMMUNICATION SKILLS: READING COMPREHENSION** | | **(Cognitive) 48/48/48*** |
| While all students should master the fundamental skills of word attack, phonetic analysis and structural analysis, the goal of all reading is the comprehension of meaning. Students respond to items based on literal or inferential comprehension of narrative or expository passages. | Literal comprehension: Students must identify main ideas, cause and effect or supporting details explicitly stated in a passage<br><br>Inferential comprehension: Students must take the meaning of a passage beyond explicit ideas by inferring main ideas, using supporting details, inferring cause and effect, drawing conclusions, predicting outcomes, determining the author's point of view or making judgements<br><br>Word meaning/contextual analysis: Students must use context clues to infer the (appropriate) meaning of a (multiple-meaning word | Each item has four multiple choice response options. A score of one point is given for each correct response. |
| **COMMUNICATION SKILLS: WRITING SKILLS** | | **(Cognitive) 60/64/60** |
| Communication skills include the ability to express ideas through writing. Students respond to objective items on some of the skills involved in writing standard edited English. This type of measurement is highly correlated with tests of actual writing. | Mechanics and usage: recognizing the application of conventions such as punctuation and capitalization<br><br>Sentence sense: recognizing clear, concise and effective sentences<br><br>Paragraph sense: recognizing coherence, unity and transition in the organization and development of paragraphs and larger units<br><br>Style, tone and flavor: recognizing effective and appropriate language for a given purpose, audience or situation | Each item has four multiple choice response options. A score of one point is given for each correct response. |
| **MATHEMATICS** | | **(Cognitive) 60/60/60** |
| Mathematics instruction should include the study of a wide range of basic concepts. Students respond to items which measure a concept itself, computation related to the concept or problem solving involving the concept. | Whole numbers<br>Fractional numbers<br>Decimals<br>Geometry<br>Measurement<br>Number patterns<br>Miscellaneous | Each item has four multiple choice response options. A score of one point is given for each correct response. |

*Numbers of items in total test at Grade 5/Grade 8/Grade11







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**ANALYTICAL THINKING** **(Cognitive) 33/32/32**

| | | |
|---|---|---|
| The ability to critically analyze information is of utmost importance to successful functioning in a complex society. Given short descriptions of problem situations involving a central character, students respond to items based on information presented in paragraphs, tables, graphs or charts. | Making inferences: the ability to distinguish valid from invalid inferences<br><br>Information processing: those skills needed in using and adding to available information<br><br>Drawing conclusions: the ability to take all available information into consideration when making a decision or solving a problem | Each item has four multiple choice response options. A score of one point is given for each correct response. |

**CITIZENSHIP/SOCIAL STUDIES** **(Cognitive) 48/80/60**

| | | |
|---|---|---|
| Basic understandings of government and how it works, history and its meanings and the fundamental processes of economics are imperative to become a fully functioning citizen. Students respond to items demonstrating their knowledge of three broad areas. | Government: the need, role, function and processes of government; leadership, power and limitations; political parties; participation in citizens' rights and responsibilities; political interdependence; conflict resolution.<br><br>History: the historical development of political and economic institutions; the development of the Constitution and its amendments.<br><br>Economics: differing economic systems; relationships of economic and political power; economic interest groups; economic rights and responsibilities; economic interdependence; basic principles of economics. | Each item has four multiple choice response options. A score of one point is given for each correct response. |

**ARTS AND THE HUMANITIES** **(Cognitive) 36/48/48**

| | | |
|---|---|---|
| Arts experiences lead to the development of self-awareness and a capacity to self-expression, which are necessary to help individuals to grow to their full potential. Exposure to the humanities can develop awareness of and sensitivity to the needs of society. Students respond to items demonstrating their knowledge of people, concepts, works and theories in five areas. | Social and critical skills: philosophy, world religions, the general concept of the humanities<br><br>Language and literature: works and authors of prose and poetry, the linguistics of the English language<br><br>Music: musical notation, musical works, composers, performers, musical instruments<br><br>Visual arts: art works, artists, arts processes and materials, architecture<br><br>Performing arts: dance, theater, plays, playwrights, performers in all areas | Each item has four multiple choice response options. A score of one point is given for each correct response. |



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| | | |
|---|---|---|
| **SCIENCE AND TECHNOLOGY** | | **(Cognitive) 36/40/44** |
| The development of scientific literacy through the school system is basic for living, working and decision making in our technological society. Students respond to items demonstrating their knowledge or comprehension of science and technology concepts or their science application or analysis/synthesis skills. | Life science<br><br>Earth and space science<br><br>Physical science<br><br>Multi-disciplinary | Each item has four multiple choice response options. A score of one point is given for each correct response. |
| **ENVIRONMENT** | | **(Cognitive) 27/40/40** |
| Environmental awareness is important to the development of practices which will lead to the maintenance and promotion of global quality of life. Students respond to items demonstrating their knowledge of five major environmental study areas and one general category of interrelationships. | Air: pollution causes and effects; noise pollution; acid rain<br><br>Land: conservation; waste disposal; pollution<br><br>Water: treatment; pollution; the water cycle.<br><br>Resources: recycling; energy sources such as fossil fuels and solar; insulation; food chains; food production<br><br>Living things: human populations; ecosystems; insecticides; introduced species; zoning<br><br>Interrelationships: ecology; environmental stewardship; problem solving. | Each item has four multiple choice response options. A score of one point is given for each correct response. |
| **HEALTH KNOWLEDGE** | | **(Cognitive) Grade 5 Only/51** |
| To develop sound health-promoting behavior, an individual must acquire a basic understanding of various health areas. Students respond to items about the requirements for physical and mental health and what practices harmful to health should be avoided. | Safety and first aid<br><br>Personal health, nutrition and physical activity<br><br>Family and consumer health<br><br>Tobacco, alcohol and other drugs<br><br>Community health, disease prevention and control<br><br>Human growth and development | Each item has four multiple choice response options. A score of one point is given for each correct response. |





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## APPENDIX B

## Description of Condition Variables or Education Indicators

## HOME ENVIRONMENT VARIABLES

| | | | |
|---|---|---|---|
| **17. PAREDUC**<br><br>Parental education | The higher level of the following was used:<br><br>(1) The students reported the highest levels of formal education attained by their fathers or male guardians.<br>(2) The students reported the highest levels of formal education attained by their mothers or female guardians. | 4 = Advanced college degree<br>3 = College graduate<br>2 = Some college, vocational, technical, business school after high school<br>1 = High school graduate<br>0 = Not a high school graduate | A higher score indicates that the school draws students from homes in which parents have higher levels of formal education. |
| **25. HOMEREAD**<br><br>Reading material in the home | The students reported the approximate numbers of magazines and books in the home. | Magazines (per month):<br>0 = None<br>1 = 1 or 2<br>2 = 3 or 4<br>3 = 5 or more<br>Books:<br>0 = 0 - 24<br>1 = 25 - 99<br>2 = 100 - 249<br>3 = 250 or more | A higher score indicates that the students report more magazines and books in their homes. |
| **20. MOBILITY**<br><br>Frequency of residence/school change | The students reported the number of different school buildings they attended within the past three years because they changed residence. | 4 = 5 or more school buildings<br>3 = 4 school buildings<br>2 = 3 school buildings<br>1 = 2 school buildings<br>0 = I have not moved within the past three years. | A higher score indicates that the students have changed residence and schools more often in the past three years. |
| **22. TVWATCH**<br><br>Student time spent watching television | The students reported their estimates of time usually spent watching television from the time they get home from school until they go to bed. | 5 = About six hours (or more)<br>4 = About five hours<br>3 = About four hours<br>2 = About three hours<br>1 = About two hours<br>0 = About one hour (or less) | A higher score indicates that the students report watching more television on school nights. |
| **26. TIMEREAD**<br><br>Time spent reading at home | The students reported how much time each day they spend reading at home. | 5 = Three hours (or more)<br>4 = Two hours<br>3 = One hour<br>2 = 30 minutes<br>1 = 15 minutes<br>0 = None | A higher score indicates that the students report spending more time reading at home. |



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| 21. SPARINT<br><br>Student perception of parental interest in school | The students reported their opinions on two items:<br><br>(1) My parents enjoy hearing about school.<br>(2) My parents feel the school is doing a good job. | 3 = Almost always<br>2 = Usually<br>1 = Sometimes<br>0 = Almost never | A higher score indicates that the students feel that their parents have a greater interest in school and a higher opinion of the job done by the school. |
| 23. PAREXP<br><br>Student perception of parental expectations<br><br>(Grades 8,11) | The students reported their perceptions of how much schooling their parents or guardians expected them to complete. | 4 = Advanced college degree<br>3 = Graduation from a four-year college<br>2 = Two-year college or other post-high school training<br>1 = Graduation from high school<br>0 = Quit high school before graduating | A higher score indicates that the students feel that their parents expect them to achieve higher educational levels. |
| 24. EDEXPECT<br><br>Student educational expectations<br><br>(Grades 8,11) | The students reported how much schooling they expect to complete. | 4 = Advanced college degree<br>3 = Graduation from a four-year college<br>2 = Two-year college or other post-high school training<br>1 = Graduation from high school<br>0 = Quit high school before graduating | A higher score indicates that the students have higher educational expectations. |
| 35. HRSWORK<br><br>Hours of employment per week<br><br>(Grade 11) | The students reported how many hours a week they work to earn money. | 4 = More than 20 hours<br>3 = 16 to 20 hours<br>2 = More than 8, but less than 16 hours<br>1 = Some, up to 8 hours<br>0 = None | A higher score indicates that students reported they work more hours a week to earn money. |

Perception of Parental Encouragement

Students reported their perceptions of how good a student their parents encouraged them to be. Answer choices included: (a) One of the best students in the class, (b) an above average student, (c) an average student, (d) do just enough to get by and (e) don't know.



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## SCHOOL ENVIRONMENT VARIABLES

| | | | |
|---|---|---|---|
| 33. CLDISCIP<br><br>Student perception of classroom discipline<br><br>(Grades 8,11) | The students reported their perceptions of discipline as a problem in the classroom. | 3 = Never a problem<br>2 = Sometimes a problem<br>1 = Usually a problem<br>0 = Almost always a problem | A higher score indicates that the students perceive their classrooms as more free of discipline problems. |
| 44. INTSCHL<br><br>Interest in school | The students reported their agreement with questions or statements about their interest in and satisfaction with their school situation.<br><br>Grade 5: 12 positive questions beginning with "How do you feel...?"<br><br>Grade 8: 10 positively-worded and 9 negatively-worded statements<br><br>Grade 11: 22 positively-worded and 6 negatively-worded statements | Grade 5:<br><br>3 = Very happy<br>2 = A little happy<br>1 = A little unhappy<br>0 = Very unhappy<br><br>For positively worded statements at Grades 8 and 11:<br><br>3 = Strongly agree<br>2 = Mostly agree<br>1 = Mostly disagree<br>0 = Strongly disagree<br><br>For negatively worded statements, the scoring is reversed. | A higher score indicates that the students are more interested in and satisfied with their school situation. |
| 28. PLANSWRK<br><br>Perceived ability to complete schoolwork<br><br>(Grade 5) | The students reported their perceptions of their ability to plan and carry out school work. | 4 = Very good<br>3 = Good<br>2 = Satisfactory<br>1 = Fair<br>0 = Poor | A higher score indicates that the students perceive they have greater ability to plan and carry out schoolwork. |
| 29. STUDYHAB<br><br>Perceived quality of study habits<br><br>(Grades 8,11) | The students reported their perceptions of the quality of their study habits. | 4 = Excellent<br>3 = Good<br>2 = Satisfactory<br>1 = Fair<br>0 = Poor | A higher score indicates that the students perceive they have higher quality study habits. |

### SELF-CONCEPT IN SCHOOL

A constructive school climate can influence the development of a positive self-concept which is important in relating to others and to becoming successful members of society. Students respond to short self-description statements about their feelings of acceptance by teachers and their classmates and of self-determination in school work, class recitation and teacher relationships.

The items are divided into three major groupings or clusters: (1) teacher relationships, (2) peer relationships and (3) school self-image.

SAMPLE ITEMS:

I feel that my teachers understand me.

I get along well with kids in my class.

I often become discouraged in school.

Response Choice

Strongly Agree
Mostly Agree
Mostly Disagree
Strongly Disagree



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Perception of Teacher Expectations

Students reported their perceptions of how good a student their teachers expected them to be. Answer choices included: (a) One of the best students in the class, (b) an above average student, (c) an average student, (d) a below average student and (e) don't know.

Perception of Testing Situation

Students reported their perceptions of the situation or conditions under which testing took place. Five items were responded to which asked whether the test administrator conveyed a sense of importance about the tests, whether they felt rushed by the test administrator, interest in the outcome of the testing and the extent to which the tests were taken seriously and responded to in a conscientious fashion.

## PERCEPTION OF INSTRUCTIONAL PROCESS VARIABLES

| | | | |
|---|---|---|---|
| 27. WRITEPAR<br><br>Frequency of writing assignments | The students reported how often they are required to write a paragraph or more as school assignments. | 4 = At least once a day<br>3 = At least once a week<br>2 = About once a month<br>1 = Only once or twice a year<br>0 = Never | A higher score indicates that the students report being required to write at least a paragraph more often. |
| 30. TIMEMATH<br><br>Time spent on mathematics assignments | The students reported the approximate amounts of time each day outside of math class they spend doing math assignments. | 4 = Two hours (or more)<br>3 = One hour<br>2 = 30 minutes<br>1 = 15 minutes<br>0 = None | A higher score indicates that the students reported spending more time outside of class on math assignments. |
| 31. TESTFREQ<br><br>Frequency of tests or quizzes | The students reported how often they have a test or quiz in most of their classes. | 4 = More than once a week<br>3 = Once a week<br>2 = Once every two weeks<br>1 = Once every three weeks<br>0 = Once a month (or less) | A higher score indicates that the students reported having more tests or quizzes in most of their classes. |
| 32. TESTRETN<br><br>Timely return of tests<br><br>(Grades 8,11) | The students reported in how many classes the teachers return tests soon after they take them. | 4 = All of my classes<br>3 = Most of my classes<br>2 = Some of my classes<br>1 = Few of my classes<br>0 = None of my classes | A higher score indicates that students reported that teachers return tests soon after administering them in more of their classes. |
| 36. MATHINST<br><br>Perception of direct instruction in mathematics<br><br>(Grades 8,11) | The students taking the class reported about how much time is usually spent on lecture and classroom discussion in mathematics class. | 4 = More than 30 minutes per class period<br>3 = 21-30 minutes per class period<br>2 = 10-20 minutes per class period<br>1 = Less than 10 minutes per class period | A higher score indicates that the students reported receiving more direct mathematics instruction through lecture and/or classroom discussion. |
| 37. ENGLINST<br><br>Perception of direct instruction in English<br><br>(Grades 8,11) | The students taking the class reported about how much time is usually spent on lecture and classroom discussion in English (literature) class. | | A higher score indicates that the students reported receiving more direct English (literature) instruction through lecture and/or classroom discussion. |



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| 38. SCIINST<br><br>Perception of direct instruction in science<br><br>(Grades 8,11) | The students taking the class reported about how much time is usually spent on lecture and classroom discussion in science class. | 4 = More than 30 minutes per class period<br><br>3 = 21-30 minutes per class period<br><br>2 = 10-20 minutes per class period<br><br>1 = Less than 10 minutes per class period | A higher score indicates that the students reported receiving more direct science instruction through lecture and/or classroom discussion. |
| 39. SOCINST<br><br>Perception of direct instruction in social studies<br><br>(Grades 8,11) | The students taking the class reported about how much time is usually spent on lecture and classroom discussion in social studies class. | | A higher score indicates that the students reported receiving more direct social studies instruction through lecture and/or classroom discussion. |

At the individual student level data was broken out differently. Separate scores were produced for items pertaining to lecture, discussion, homework and silent reading.



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